

**WHAT IS CLAIMED IS:**

- 1        1. A differential interferometric confocal microscope for measuring an object,  
2    said microscope comprising:
  - 3        a source-side pinhole array;
  - 4        a detector-side pinhole array; and
  - 5        an interferometer that images the array of pinholes of the source-side pinhole  
6    array onto a first array of spots located in front of an object plane located near where the  
7    object is positioned and onto a second array of spots behind the object plane, wherein the  
8    first and second arrays of spots are displaced relative to each other in a direction that is  
9    normal to the object plane, said interferometer also (1) imaging the first arrays of spots  
10   onto a first image plane that is behind the detector-side pinhole array, (2) imaging the  
11   first array of spots onto a second image plane, (3) imaging the second array of spots onto  
12   the second image plane, and (4) imaging the second array of spots onto a third image  
13   plane that is in front of the plane defined by the detector-side pinhole array,  
14        wherein each spot of the imaged first array of spots in the first image plane is  
15   aligned with a corresponding different spot of the imaged second array of spots in the  
16   second image plane and a corresponding different pinhole of the detector-side pinhole  
17   array, and  
18        wherein each spot of the imaged first array of spots in the second image plane  
19   coincides with a corresponding different spot of the imaged second array of spots in the  
20   second image plane and is aligned with a corresponding different pinhole of the detector-  
21   side pinhole array.
- 1        2. A differential interferometric confocal microscope for measuring an object,  
2    said microscope comprising:
  - 3        a source-side pinhole array for producing an array of input beams; and
  - 4        a detector-side pinhole array; and
  - 5        an interferometer including:
    - 6        a first optical element providing a first reflecting surface;
    - 7        a second optical element providing a second reflecting surface; and

8        a beam splitter positioned between the first and second optical elements,  
9        wherein the beam splitter produces from the array of input beams a first array of  
10      measurement beams and a second array of measurement beams,  
11        wherein the first reflecting surface participates in focusing the first array of  
12      measurement beams onto a first array of locations on a first object plane in object space  
13      and the second reflecting surface participates in focusing the second array of  
14      measurement beams onto a second array of locations on a second object plane in object  
15      space, said first and second object planes being parallel to and displaced from each other,  
16        wherein the first array of measurement beams generates a first array of return  
17      beams from the object and the second array of measurement beams generates a second  
18      array of return beams from the object,  
19        wherein the first and second reflecting elements participate in producing from the  
20      first array of return beams (1) a first array of converging beams that converge to a first  
21      array of spots on a first image plane and (2) a second array of converging beams that  
22      converge onto a second array of spots on a second image plane,  
23        wherein the first and second reflecting elements participate in producing from the  
24      second array of return beams (1) a third array of converging beams that converge onto the  
25      second array of spots on the second image plane and (2) a fourth array of converging  
26      beams that converge onto a third array of spots on a third image plane,  
27        wherein said first and third image planes are adjacent to and on opposite sides of  
28      the detector-side pinhole array, and the second image plane lies between the first and  
29      third image planes, and  
30        wherein the detector-side pinhole array combines the first, second, third, and  
31      fourth arrays of converging beams to form an array of output beams.

1            3. The differential interferometric confocal microscope of claim 2 wherein a  
2      single pinhole array serves as both the source-side pinhole array and the detector-side  
3      pinhole array.

1            4. The differential interferometric confocal microscope of claim 3, wherein the  
2      first optical element is located between said single pinhole array and the beam splitter and

3 wherein the second optical element is located between a location at which the object is  
4 positioned during use and the beam splitter, wherein the first reflecting surface has a  
5 center of curvature for which there is a corresponding conjugate as viewed through the  
6 beam splitter, and wherein the second reflecting surface has a center of curvature that is  
7 displaced relative to the corresponding conjugate of the center of curvature of the first  
8 reflecting surface.

1       5. The differential interferometric confocal microscope of claim 4, wherein the  
2 conjugate of the center of curvature of the first reflecting surface and the center of  
3 curvature of the second reflecting surface are displaced from each other in a direction that  
4 is normal to a plane defined by the beam splitter.

1       6. The differential interferometric confocal microscope of claim 5, wherein the  
2 first reflecting surface participates in focusing the first array of measurement beams via  
3 the beam splitter onto the first array of locations and the second reflecting surface  
4 participates in focusing the second array of measurement beams via the beam splitter  
5 onto the second array of locations.

1       7. The differential interferometric confocal microscope of claim 6 wherein the  
2 first reflecting surface is substantially concentric with a point on the object.

1       8. The differential interferometric confocal microscope of claim 8, wherein the  
2 second optical element provides a refracting surface positioned between the object and  
3 the beam splitter to receive light rays from the object.

1       9. The differential interferometric confocal microscope of claim 9, wherein the  
2 first reflecting surface substantially conforms to a sphere having a first radius and the  
3 refracting surface conforms to a sphere having a second radius, wherein the first radius is  
4 greater than the second radius.

1       10. The differential interferometric confocal microscope of claim 9, wherein the  
2 first optical element provides a refracting surface positioned between the beam splitter  
3 and said single pinhole array.

1        11. The differential interferometric confocal microscope of claim 10 wherein the  
2 second reflecting surface is substantially concentric with an image point on said single  
3 pinhole array.

1        12. The differential interferometric confocal microscope of claim 11, wherein the  
2 second reflecting surface substantially conforms to a sphere having a first radius and the  
3 refracting surface conforms to a sphere having a second radius, wherein the first radius is  
4 greater than the second radius.

1        13. The differential interferometric confocal microscope of claim 6, wherein said  
2 single pinhole array is a two-dimensional array.

1        14. The differential interferometric confocal microscope of claim 13, wherein the  
2 two-dimensional array is of equally-spaced holes.

1        15. The differential interferometric confocal microscope of claim 14, wherein the  
2 equally-spaced holes are circular apertures.

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